FEEDING ECOLOGY OF THE BONNET MACAQUE AT THE MUNDANTHURAI SANCTUARY, TAMILNADU[1]

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(*With three text-figures*)

The feeding ecology of the Bonnet Macaque (*Macaca radiata diluta*) is discussed. 68 plant species were observed being eaten, but this is nowhere near the maximum. Fruits and insects constituted the bulk of the diet. Super abundant food sources like fruiting fig trees accounted for the majority of feeding observations.

Various propositions dealing with aspects of feeding behaviour are examined.

Introduction

Many potential causes affect feeding behaviour in primates. There is a constant interaction between the distribution of food resources, and the utilisation of these resources by the primates in that area. Previous studies have highlighted various factors that affect feeding. Among these are the need to increase the diversity of the food items eaten (Marsh 1978) and the need to avoid compounds in plant material that are potentially poisonous to the monkey, such as the various alkaloids and tannins normally present in leaf material (McKey 1978, Oates, *pers. comm.*) Some primates such as the Nilgiri Langur, have been shown to select food material which is easily chewed (Oates, *pers. comm.*). Competition between various species in the area may be a factor.

The bonnet macaque has been shown in previous studies to be largely fruit-eating, with a large component of insects in its diet (Nolte 1955, Simonds 1965, Kuruvilla 1976). However, the first two studies concentrated on roadside troops of bonnet macaques, which had adapted to living in man-modified areas. Kuruvilla studied a northern population on Elephanta island. I report below on a study conducted at the Mundanthurai Sanctuary in Tamil Nadu, on the southern race *Macaca radiata diluta.* Observations were made intensively on one group of bonnet macaques between February 1977 and April 1978 at this site.

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Description of study area

The study area was at Mundanthurai, in the Mundanthurai Sanctuary in Tamil Nadu. The group ranged along the banks of the Thambraparni and Servalar rivers, at an altitude of 180 m (*c.* 8°40′N, 77°28′E). The vegetational patterning of the study area is complex. Along the river banks, the flora is typical of forest normally found at a higher altitude, and based on species composition could be classified as dry evergreen (Champion and Seth 1962). The commonly occurring large tree species in the area are *Pongamia glabra, Hopea utilis, Callophyllum elatum, Mangifera indica, Syzygium cumini, Mesua ferrea,* and *Hopea parviflora.* The medium and small trees include species such as *Walsura piscida, Aglaia roxburghiana,*

Diospyros peregrina, Diospyros montana, Memecylon angustifolium, Vitex leucoxylon and *Syzygium lineare,* an endemic locally very common along the river bank. *Glycosmis pentaphylla, Tetracera laevis* and *Pandanus tectorius* are the commonest shrubs along the river bank.

Away from the river, the vegetation changes, being more characteristic of a dry mixed deciduous type. The most frequently occurring trees and shrubs are *Randia malabarica* and *Limonia alata. Atalantia monophylla,* neem (*Azadirachta indica*), tamarind (*Tamarindus indicus*), *Orophoea thompsonii* and *Alphonsea sclerocarpa* are also abundant. *Chloroxylon swietenia, Dalbergia latifolia, Terminalia, bellerica,* and sandalwood (*Santalum album*) are also frequent. The understorey consists of *Pavetta thompsonii, Mundulea suberosa* and several herbaceous species including *Crotolaria* spp.

A portion of the study area has been planted with teak. In the last few years however, little effort has been made to perform silvicultural operations here, in line with sanctuary management practices, and a fair amount of natural vegetation has now regenerated in these plantations. Finally, there are areas which were cleared for tapioca cultivation a few years ago, and then abandoned after being planted with economically useful species. This common but destructive practice, known as *kumri* cultivation, has resulted in large patches becoming grasslands. Some of these patches, into which macaque groups enter to forage for insects, are now maintained as grassland by regular burning, to improve herbivore pasture. Other areas subject to *kumri* cultivation are now covered with low, dense, thorny scrub consisting largely of *Dichrostachys cinerea, Mundulea suberosa, Salmalia malabarica, Ailanthus excelsa, Albizzia lebbeck* and *Chloroxylon swietenia.* These were still fairly small when the study was begun.

One of the most important genera of plants for the macaques is *Ficus.* Many species are found in this area. *F. bengalensis* is found both by the river, and away from it, but is not common. *F. retusa* is very common by the riverside. *F. talboti* is rare, but heavily used when in fruit. A few *Ficus glomerata* and *F. mysorensis* also occur on the river banks.

Climbers and twiners are abundant. The most common among these is *Zizyphus oenoplia, Combretum decandrum* and *Ventilago madaraspatensis* also occur. Even though herbs and lower ground flora were not enumerated, two deserve mention: *Lantana aculeata* and *Eupatorium odoratum* both occurred. *Lantana* was found by the riverside, and *Euptatorium* had begun invading those areas which had been recently cleared. A species-area curve (Fig. 1) for all vegetation over 3 m high shows the high diversity of the flora in a very limited area at this location.

Besides the plantations, another major habitat modification has occured. The construction of the Thambraparni Upper Dam in 1943, upstream on the Thambraparni, appears to have caused a major change in soil hydrology on the whole Mundanthurai Plateau. Forest records indicate that the vegetation has changed to a drier type than before, with species like *Pterocarpus marsupium,* which were once abundant, having all but disappeared in the study area.

The construction of the dam has had another consequence: since the waterflow in the stream is now controlled for irrigation purposes, the maximum flow in the river is at the driest times of the year. This has resulted in an obvious change in plant phenology. An

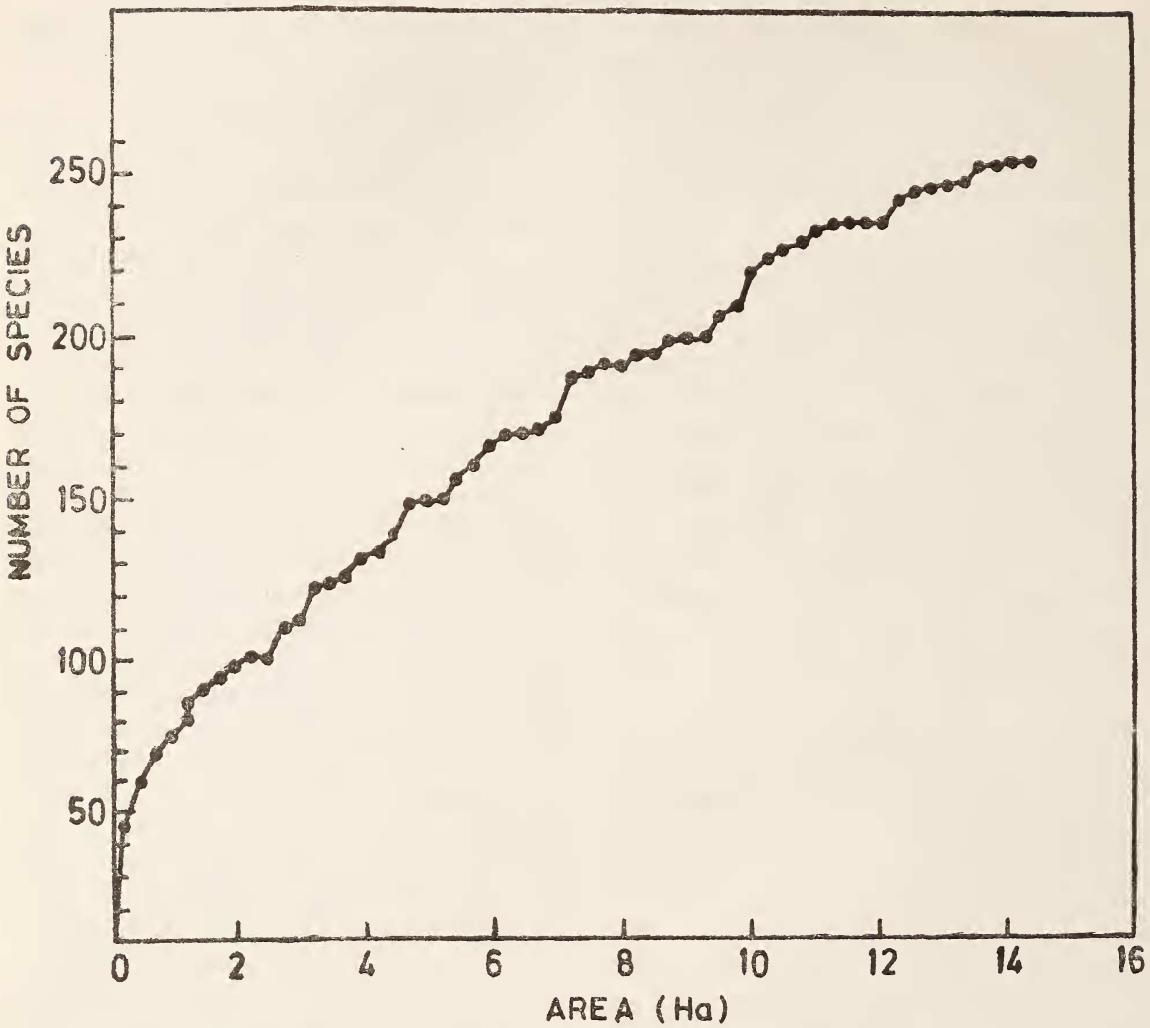

Fig. 1. Species area curve for vegetation over 3 m in height. (N.B. — Some quadrants contain patches of water as well).

example is that the flowering of *Glycosmis pentaphylla* along the Thambraparni and Servalar rivers differs by as much as a month. Also, since the river acts as a barrier to the movements of certain animals, the accessibility of certain areas to certain species of animals is arbitrarily determined, rather than being seasonal.

In spite of these disturbances, there is an impressive population of mammals found in the area. Among the predators, Leopard (*Panthera pardus*) and Wild Dog (*Cuon alpinus*) were frequently encountered. Tiger (*Panthera tigris*) was seen twice within the area, as was the Jungle Cat (*Felis chaus*). The most common ungulates were the Chital

(*Axis axis*) and the Sambar (*Cervus unicolor*). A high density of mouse deer (*Tragulus meminna*) was also found, along with wild pig (*Sus scrofa*). Elephants were normally found higher up in the hills, though in one instance an injured tusker spent a few weeks at the edge of the study area.

Among the arboreal mammals, the Malabar Giant Squirrel (*Ratufa indica*) was common. Nilgiri Langur (*Presbytis johnii*) was found in the study area, though at much lower densities than in the *Sholas* higher up. The population of Nilgiri Langurs displayed several curious characteristics, such as a sex ratio highly skewed in favour of males, and female transfers [see Ali *et al.*, (1985) for details]. They were replaced by common langur (*Presbytis entellus*) about 1 km downstream from the study area. Slender Loris (*Loris tardigradus*) was also abundant in the area.

Over a hundred species of birds were recorded from this area. Possible predators of the bonnet macaque included the Crested Serpent Eagle (*Spilornis cheela*) and the Black Eagle (*Ictinaetus malayensis*). The appearance of either caused the macaques to alarm-call and seek cover in the ground vegetation. The Wryneck (*Jynx torquilla*) and Orange-headed Ground Thrush (*Zoothera citrina cyanotus*) have also seldom been recorded from so far south in the peninsula. Shikra (*Accipiter badius*) regularly associated themselves with macaque groups, and were seen feeding on insects disturbed by macaque movements.

To complete the profile of the fauna in the area the larger reptiles included the Python (*Python molurus*), King Cobra (*Naja hannah*), Cobra (*Naja naja*), Ratsnake (*Ptyas mucosus*) and Monitor Lizard (*Varanus bengalensis*). Mugger (*Crocodylus palustris*) were wiped out several years ago, but have recently been reintroduced.

Methods

A group of bonnet macaques was followed, from early morning till the time the group had gone to sleep. Sampling was carried out in a fashion similar to Oates (1978), Kuruvilla (1976), Green and Minkowski (1977) and Struhsaker (1975) with sampling periods of 5 minutes, followed by a 'rest' interval of 10 minutes. There were 4 samples taken each hour, and initially 5 animals were sampled in each. Later, as the group habituated the number was increased to 8. After an animal was sighted, five seconds were allowed to lapse before its activity was noted. This was to eliminate any possible bias due to the animal being sampled performing an activity that made it conspicuous. When an animal was scored as feeding, the food and item were noted, as well as the height of the animal sampled and the height of the tree it was on. Kani (local tribal) names were used initially, until the plant was identified. These names proved to be completely consistent.

Plant species eaten

A list of plant species eaten is given in Table 1. There were 68 plant species that were recorded as being fed upon, and the plant part eaten is given in each case. The great majority of these were only eaten occasionally. A separate list gives the top 24 food species. These accounted for over 92 per cent of all feeding. The relative rank in the month of maximum use is given, as well as the month (Table 2).

The most heavily used plant was the tama-

TABLE 1

LIST OF PLANT SPECIES EATEN BY THE STUDY GROUP (IN ORDER FIRST SEEN FED UPON)

THE NAMES USED ARE FROM GAMBLE & FISCHER (1967)

	Species	Tribal name	Type	Part Eaten
1.	*Tectona grandis*	Thekku	Large Tree	BK
2.	*Syzygium lineare*	Vinji	Small Tree	LBU
3.	*Syzygium cumini*	Navat	Large Tree	FR, LGA, FLB, BK
4.	*Mangifera indica*	Ma	Large Tree	BK
5.	*Ficus retusa*	Ala	Medium-sized Tree	FR
6.	*Ficus bengalensis*	Ala	Tree	FR, BK
7.	*Combretum decandrum*	Maduravelli/ Kidavelli	Liana/ Climber	FR, ML, LGA, TEN, YL, B
8.	*Dendrocalamus strictus*	Mungil	Bamboo	YLP
9.	*Tamarindus indicus*	Puli	Tree	FR, ML, YL
10.	*Zizyphus oenoplia*	Pulichi	Climber	FR
11.	*Memecylon edule*	Kancham	Large shrub	FR, ML
12.	*Diospyros peregrina*	Palinji	Small tree	FR, BK
13.	*Diospyros montana*	Vakkanai	Tree	FR, YL, ML, FRB
14.	*Albizzia lebbeck*	Vahai	Tree	BK, FLB
15.	*Pongamia glabra*	Pung	Tree	
16.	*Azadirachta indica*	Vembu	Small tree	ML, BK
17.	Unid. sp. 1	Mututengu	Large shrub	ML, FR, FL
18.	*Ficus glomerata*	Atthi	Tree	FR
19.	*Pandanus tectorius*	Thani	Shrub	FR, PTH
20.	*Lantana aculeata*	—	Sorambler	ML, FR
21.	*Ficus talboti*	Atthi	Tree	FR
22.	*Pavetta thomsonii*	Pavattai	Shrub	FR, FLB, FL
23.	*Mitrephora heyneana*	Nedunarai	Tree	FR
24.	*Orophoea thomsonii*	Nedunarai	Shrub	FR, FLB
25.	*Alphonsea sclerocarpa*	Nedunarai	Tree	FR, YL, FRB
26.	*Mesua ferrea*	Nangu	Large tree	FL
27.	*Randia malabarica*	Mulli	Shrub	FR
28.	*Glycosmis pentaphylla*	Manthai	Small shrub	FR
29.	*Phyllanthus polyphyllus*	Katnelli	Small tree	FR, FRB
30.	*Carissa opaca*	Klaka	Shrub	FR, FRB
31.	Unid. sp. 2	Erukalai	Small tree	
32.	*Clerodendrum infortunatum*	—	Small tree	
33.	*Aglaia roxburghiana*	Chokla	Small tree	FR, FL
34.	*Erythroxylum monogynum*	Chenpuna	Shrub	FR
35.	*Mothopegia beddomei*	Charamaram	Small tree	FR
36.	*Grewia tiliaefolia*	Velle-Unnu	Small tree	FR
37.	*Grewia orientalis*	Kar-unnu	Small tree	FR
38.	*Calophyllum elatum*	Toraipanna	Large tree	FL

TABLE 1

Species	Tribal name	Type	Part eaten
39. *Terminalia bellerica*	Tani	Large tree	FR
40. *Randia dumetorum*	Karai	Shrub	FR, ML
41. *Maba buxifolia*	Karun thovarai	Small tree	FR
42. *Cassia fistula*	Konnai	Large Tree	?
43. Lauraceae sp. 1	Kanjiramkodi	Climber	FR
44. Unid. sp. 3	Chennelli	Shrub	FR
45. *Santalum album*	Sandana	Small Tree	FR
46. *Limonia alata*	Katnaru	Large shrub	FRB, FR, BK
47. *Helecteres isora*	Kasuva	Rambling shrub	FL
48. Cucurbitaceae sp. 1	Chadavelli	Twiner	ML
49. *Bauhinia longifolia*	Arampuli	Small Tree	FRB
50. *Mundulea suberosa*	Pul-avarai	Shrub	?
51. Unit. sp. 4	Katvelli	Twiner	ML
52. *Buettneria* sp.	Kasuva	Climber	FR, FL
53. *Acacia caesia*	Korung-senjai	Climber	?
54. *Manihot utilissima*	Tapioca	Herb	RT
55. Unid. sp. 5	Kutapra	Shrub	FL
56. *Hugonia mystax*	Manjakodi	Climber	FR
57. *Eupatorium odoratum*	Poga-elai kodi	Herb	ML
58. *Bauhinia racemosa*	Arampuli	Small Tree	FR
59. *Ficus mysorensis*	Kat Atthi	Tree	FR
60. *Dalbergia paniculata*	Adukuvahai	Tree	FRB
61. *Celastrus paniculata*	Vembaladan	Climber	YL
62. *Vitex leucoxylon*	Nirvitti	Tree	YL
63. *Flacourtia* sp.	Kathikarai	Shrub	?
64. *Crotolaria* sp.	—	Herb	?
65. Unid. sp. 6	Mulli	Shrub	?
66. *Toddalia asiatica*	Mulli	Rambling shrub	FR
67. *Albizzia amara*	Usil	Small Tree	BK
68. *Atalantia monophylla*	Kat-elumichai	Shrub	FR, BK, ML

KEY TO ABBREVIATIONS

LBU — Leaf bud; ML — Mature leaf; YL — Young leaf; YLP/SHT — Young leaf patiole; BK — Bank; FR — Fruit; FRB — Fruit bud; FL — Flower; FLB — Flower Bud; RT — Root; TEN — Tendril; LGA — Leaf gall; PTH — Pith; ? — Part Unidentified.

TABLE 2

THE TOP 24 FOOD PLANT TAXA UTILISED BY THE STUDY GROUP

	Species	Total % in diet	% Eaten monthly maximum	Rank in month	No. months eaten*
1.	*Tamarindus indicus*	21.25	26.9 (Jan. '78)	1	10
2.	(Insects)	13.37	28.8 (Oct. '77)	1	14
3.	*Ficus retusa*	12.76	53.6 (Mar. '78)	1	9
4.	*Dendrocalamus strictus*	5.95	22.0 (Oct. '77)	2	12
5.	*Ficus talboti*	5.37	39.4 (Apr. '78)	1	4
6.	*Zizyphus oenoplia*	5.33	27.9 (Apr. '77)	1	4
7.	Grasses spp.	3.83	11.2 (Dec. '77)	2	12
8.	*Syzygium cumini*	3.10	29.3 (Feb. '77)	1	10
9.	*Memecylon edule*	2.88	8.78 (Nov. '77)	3	9
10.	*Diospyros montana*	2.54	19.6 (Jun. '77)	1	6
11.	(Assorted herbs)	2.11	4.2 (Jun. '77)	4	11
12.	*Santalum album*	2.02	9.3 (Feb. '78)	4	6
13.	*Randia malabarica*	1.78	6.8 (Nov. '77)	4	6
14.	*Alphonsea sclerocarpa*	1.44	11.5 (Nov. '77)	2	4
15.	*Ficus bengalensis*	1.34	12.5 (May '77)	1	5
16.	*Orophoea thomsoni*	1.15	33.3 (Feb. '79)	1	3
17.	Tiliaceae sp. 1	1.06	3.8 (Mar. '78)	4	4
18.	*Phyllanthus polyphyllus*	0.96	6.1 (Nov. '77)	5	5
19.	*Glycosmis pentaphylla*	0.91	6.8 (Oct. '77)	3	4
20.	Mushrooms/fungi)	0.91	2.9 (Jan. '78)	4	5
21.	*Lantana* sp.	0.76	3.8 (Apr. '78)	4	5
22.	*Combretum decandrum*	0.76	3.4 (Oct. '77)	4	8
23.	*Pandanus tectorius*	0.52	5.1 (Sep. '77)	5	3
24.	*Diospyros peregrina*	0.52	2.2 (Sep. '77)	6	6
		92.02%			

* Max: 14 months.

rind (*Tamarindus indicus*). Normally both the ripe and unripe fruits were eaten, though young leaves accounted for a majority of the feeding observations made on this species in June 1977, when it was the second most heavily used food item.

An interesting aspect about tamarind use is that it must be a comparatively recent phenomenon. Tamarind was introduced from East Africa about 500 years ago (Gamble and Fischer 1967). It now grows wild over a considerable area but is seldom found at high densities at any given place. Its intensive use by macaques is a pointer to their adaptability. The presence of tannins in the unripe fruit, which is indicated by the astringent taste, does not seem to inhibit feeding on it even slightly.

Of the five *Ficus* species in the area, three: *F. talboti, F. bengalensis* and *F. retusa* formed a major component of feeding, with the ripe fruit being eaten. In March and April

1978, two trees — one of *F. retusa* and one of *F. talboti* — alone accounted for over 40 per cent of all feeding records. *Ficus* form the major food of a number of primate species (Hrdy 1979) and there is a suggestion that a degree of co-evolution has occurred between monkeys and figs (Mackinnon, *pers. comm.*): a hypothesis which remains untested at the moment. Figs provide a major source of protein because of the wasps that are resident within them. Interestingly, one of the species not eaten by the macaques — *Ficus glomerata* — has waterborne seed dispersal. The three that are eaten fruit in a short time span once a year, and attract a large number of animal and bird species at this time — including, apart from the monkeys, giant squirrels and palm squirrels, as well as koels, green barbets and malkohas.

Bamboos also form a major food item of the two species found in the study area, *Bambusa bambos* had just flowered and consequently, was unavailable as a food. Several clumps of *Dendrocalamus strictus* were found in the study area, and the monkeys fed by pulling off the young leaves from their sheaths and nibbling off the petiole. This was the only part of the plant that was eaten.

The ripe fruit of *Zizyphus oenoplia* was available between February and April. It ranked among the top 5 food items in these months. In February 1979, feeding on this was not observed and field protocols indicate that the fruit was unripe at this time.

Among the other foods available, Sugiyama (1971) records *Syzygium cumini* as being a major food item of the bonnet macaque. However, in this area, this species was ranked only 8th overall. The maximum number of feeding records on it did not consist of fruit, but of leaf-galls, which are another potentially good protein source for the macaques.

Of the *Diospyros* species in the area, *D. montana* fruits were eaten whenever available, even when unripe. However, *D. peregrina* fruits, which were regularly eaten by groups of liontailed macaques in the vicinity, were seldom touched. Seed dispersal in this species is by means of water, and ripe fruit were often seen floating down the river. The mesocarp is very resinous, and this could be one reason why it was not eaten. The majority of feeding observations on this were made on one old male. He would pluck the fruit, walk down to the river with it, and wash it in between bites. I tried this and found that washing the fruit reduced the amount of resin in the mesocarp, rendering it more palatable. However, none of the other animals in the group seemed to have developed this habit.

Herbs and grasses also formed a substantial part of the diet, together with certain mushrooms when available. Insects ranked among the top 5 food items each month, forming up to 30 per cent of the diet in each month. These included various species of crickets, cicadas and termites; caterpillars were also eaten. Animals would stalk crickets, and there seems to be a difference in the number of successful captures among the animals in the group.

On one occasion, the group was seen outside a swarming termite mound, grabbing termites both from the air, and picking them up from the ground. Termites caught flying would be held by the wings. The body would then be bitten off and the wings discarded. A calculation based on feeding rates and the amount of time each animal fed shows that within 150 minutes, over 22,000 termites were eaten by the 16 animals in the group!

A breakdown of the various food items

eaten is given in Table 3. The amount of insect-eating decreases when fruit-eating increases. The extent to which both contain the same constituents awaits a detailed nutritional analysis.

A diversity index, H' was used to test for the variety of food items in each month. The more items that are used, the higher the diversity index, and the more equally they are used, the higher the value of the index, also. H' is derived by using the following formula

$H' = \Sigma\ p_i \ln p_i$

where Pi is the proportion of the i-th item in the diet & log is the natural logarithm. This is summed for all food items eaten: in this case, *n* food items. Correlations using the diversity of food items shows that as the proportion of fruit in the diet increases, the diversity of feeding: in this case the evenness — on all other items also increases ($r_s = 0.7$, $p < 0.01$). (Fig. 2).

Variations between age-sex classes and over time

There is significant variation in the amount of time spent feeding, both between age-sex classes, and between months. The maximum any age-sex class was recorded feeding was for subadult males, who spent 28 per cent of their time feeding in February 1977. Minimum feeding was also recorded for subadult males, who fed for only 8.7 per cent of their time feeding in February 1979. This was after a cyclone, in November 1978, when both adult males disappeared. The subadult males had risen in the dominance hierarchy, and group ranging patterns had changed substantially at this time.

In general, feeding varied between 15-25 per cent of total activity for all animals, in each month (Fig. 3). Adult males, on average, spent the least amount of time feeding. Subadult males spent the most, followed closely by the subadult females, with juveniles feeding less than both. Between months, the maximum time spent feeding was recorded in October 1977, and the minimum in May 1977. These differences are significant ($F_{12,36} = 3.39$, $p < 0.01$).

Feeding patterns also vary over the day. For analysis days were divided into 3 blocks from 6-10 a.m. (morning), 10 a.m.-2 p.m. (noon) and 2 p.m.-6 p.m. (afternoon). Different amounts of time are spent feeding in each period ($\chi^2 = 43.57$ with 2 d.f., $p < 0.01$), with more feeding than expected in the evening, and less than expected in the noon period. More interestingly, variations in the items eaten over the day were also noted, with significantly more fruit being eaten in the mornings ($\chi^2 = 25.62$ with 2 d.f., $p < 0.005$) and more bamboo being eaten in the afternoons ($\chi^2 = 73.43$ with 2 d.f., $p < 0.005$). However, the intake of insects remains fairly constant over the day ($\chi^2 = 1.56$, n.s.) as does the intake of foliage.

The increased intake of bamboo in the afternoons leads one to speculate that bamboo leaf-petioles may be eaten as a 'filler' if the group has not fed sufficiently during the day. An alternative explanation is that bamboo clumps coincidentally happen to be near sleeping sites, resulting in their use in the evenings. Several attempted correlations, however, failed to distinguish between these two hypotheses.

Postscript

Approaches such as the one given above show clearly the pitfalls in a qualitative approach. It is useful to refer to Prasad *et al.* (1978) attempts to explain the factors govern-

TABLE 3

THE PERCENTAGE OF EACH ITEM IN THE DIET DURING EACH MONTH, AND FEEDING DIVERSITY

UND — Undetermined; INS — Insect; FR — Fruit; FRB — Fruit bud; ML — Mature leaf, YL — Young leaf; YLP — Young leaf petiole; LGA — Leaf galls, BOO — Bamboo, RT — Root, FL — Flower bud, BAR — Bark, SD — Seed, MUSH – Mushrooms.

	UND	INS	FR	FRB	ML	YL	YLP	LGA	BOO	RT	FL	FLB	BAR	SD	MUSH	Sample Size (N)	Diversity (H)
Feb. 1977 %	40.8	6.4	22.9	0.6	0.6	—	—	1.3	0.6	—	—	26.8	—	—	—	157	1.19
Apr. 1977	37.5	6.25	48.6	—	1.4	2.1	—	—	1.4	—	—	—	2.8	—	—	144	0.849
May 1977	49.0	4.9	41.2	—	—	—	—	—	—	—	1.0	1.0	2.9	—	—	102	0.714
Jun. 1977	14.9	10.6	36.7	—	10.1	17.0	0.5	—	1.6	—	3.7	1.1	2.1	1.6	—	188	1.66
Aug. 1977	16.7	34.5	27.4	—	—	7.1	—	—	3.6	1.2	1.2	1.2	3.6	2.4	1.2	84	1.558
Sep. 1977	11.8	10.7	37.1	1.1	5.1	1.1	—	—	22.4	—	0.6	0.6	9.6	—	—	178	1.552
Oct. 1977	13.6	28.6	19.9	—	3.9	2.4	—	1.5	24.8	—	0.5	1.0	1.9	—	1.9	206	1.621
Nov. 1977	17.6	4.2	63.4	—	5.6	—	—	—	4.9	—	0.7	0.7	0.7	0.7	1.4	142	0.935
Dec. 1977	10.1	5.8	62.9	1.1	3.6	—	—	0.7	4.3	—	9.4	—	0.7	—	1.4	278	1.131
Jan. 1978	14.5	9.8	62.5	0.4	3.3	0.4	—	—	2.2	—	0.7	1.8	1.5	—	2.9	275	1.054
Feb. 1978	3.3	9.3	78.9	0.7	1.9	—	—	—	3.0	0.4	1.5	—	1.1	—	—	270	0.75
Mar. 1978	3.8	5.8	84.6	1.7	1.4	1.0	—	—	0.3	—	0.7	—	0.7	—	—	293	0.552
Apr. 1978	21.2	8.9	52.5	2.1	3.4	1.7	—	—	5.1	0.8	—	1.3	3.0	—	—	236	1.248
Feb. 1979	6.6	24.6	45.9	4.9	—	3.3	—	—	3.3	4.9	6.6	—	—	—	—	61	1.433
Total (Means)	16.3	10.6	53.4	0.8	3.2	2.2	0.04	0.3	5.7	0.3	1.9	2.2	2.1	0.23	0.73		

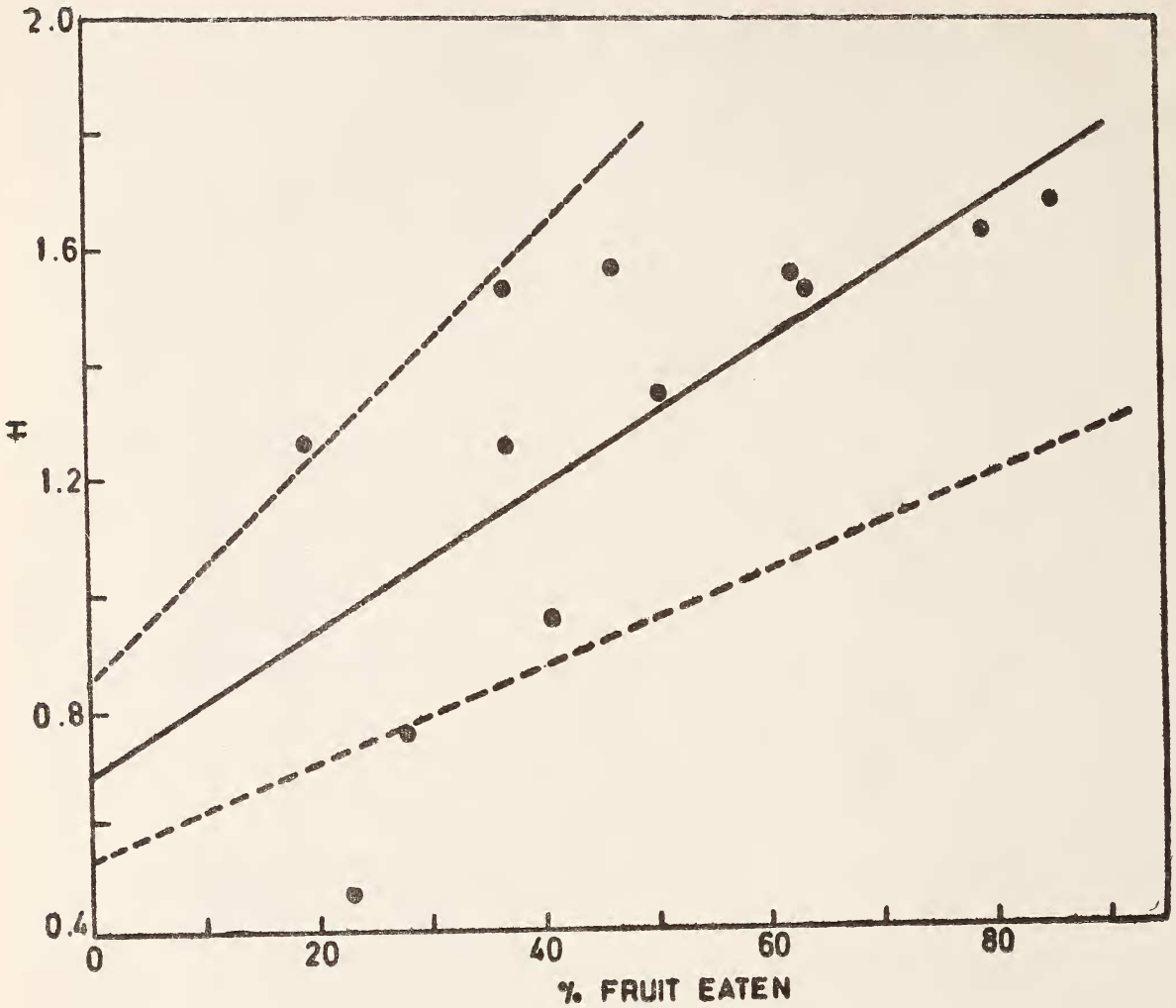

Fig. 2. Evenness of feeding on other food items as proportion of fruit in diet increases.

ing the distribution of mammals in Karnataka. Reference to the relevant data for bonnet macaques (p. 737, Table 2), and the foregoing detailed figures show how inaccurate the original figures were. Grass and tree leaves are certainly not absent from the diet. Eating of seeds is rare, and not common. For the rest, it is difficult to arrive at any kind of qualitative distinction between 'common' and 'abundant'. Does one average it over the year or take any one month, how does differential sampling of age-sex classes affect the results, and how does one account for group size affecting what is eaten — all factors that are likely to play important roles?

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The field work of which this paper forms a

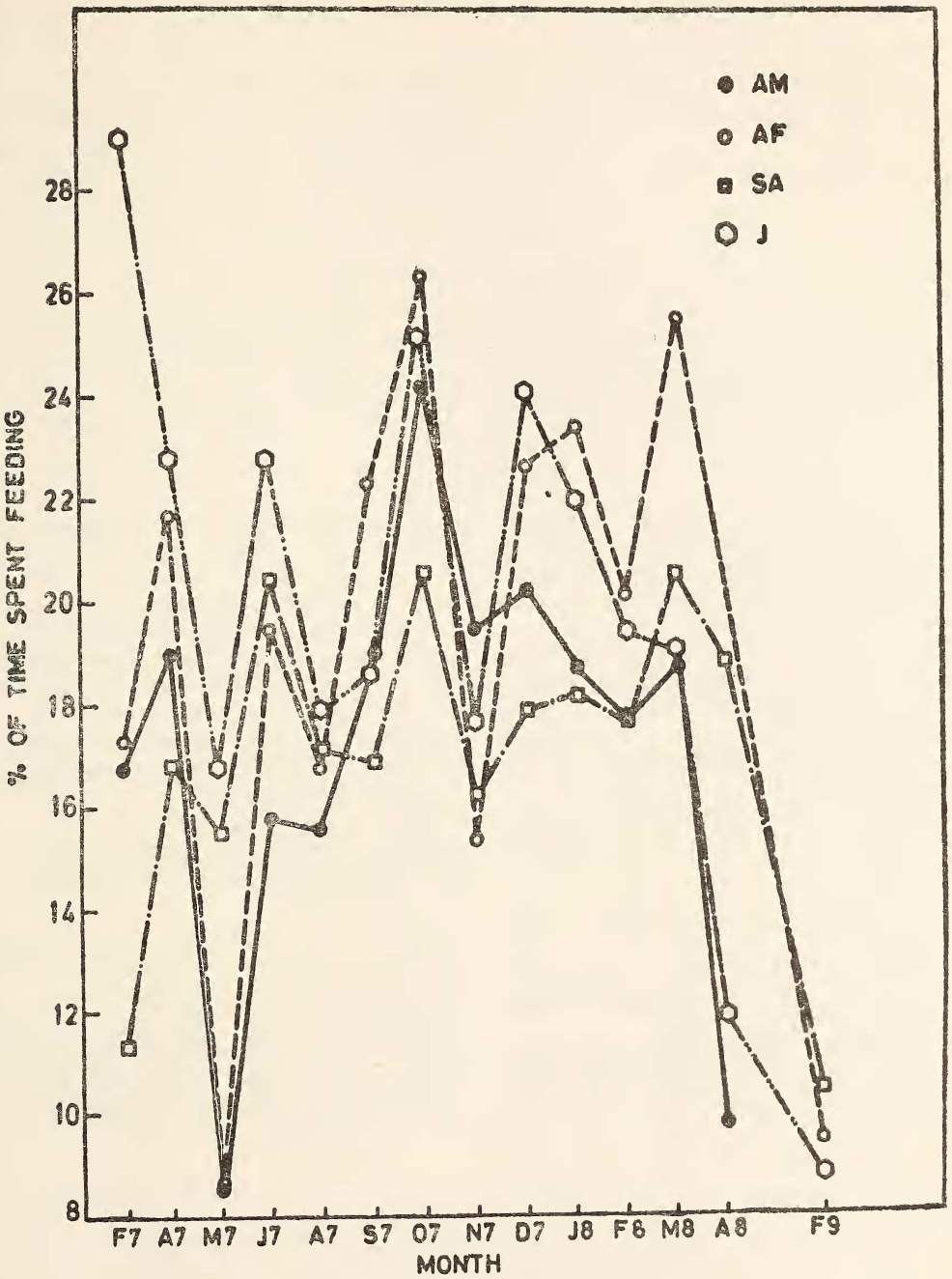

Fig. 3. Monthly feeding by each age-sex class.
N.B.: AM—Adult male; AF—Adult female; SA—Subadult male; J—Juvenile.

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